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Section VIII.—Semimenstrual inequality in time, proportion of solar and lunar effects as shown by times, and apparent age of tide as shown by times, from high water and from low water.

Section IX.—Formation of the time of diurnal high water; progress of the diurnal tide-wave round the island; comparison of its progress and range with those of the semidiurnal tide.

Section X.—Method of expressing the height of the water throughout every individual tide, by sines and cosines of arcs; and expressions in this form for every tide in the whole series of observations, except those at Courtown.

Section XI.—Discussion of the height of mean water deduced from the analysis of individual tides; with reference to difference of station, and to variations of the phase of the moon, and of the declination of the moon.

Section XII.—Discussion of range of tide, or coefficient of first arc, in the analysis of individual tides; and of semimenstrual inequality in range, apparent proportion of solar and lunar effects, and age of tide as deduced from range.

Section XIII.—Establishment of each port, as deduced from the time of maximum of the first periodical term in the analysis of individual tides.

Section XIV.—Semimenstrual inequality in time, proportion of solar and lunar effects from times, and apparent age of tide as shown by times, deduced from the time of maximum of the first periodical term.

Section XV.—Comparison of the results as to mean height, range, semimenstrual inequality in height, age of tide obtained from height, establishment, semimenstrual inequality in time, and age of tide obtained from time, deduced from high and low waters only, in Sections V., VI., VII., VIII., with those deduced from the analysis of individual tides in Sections XI., XII., XIII., XIV.

Section XVI.—Remarks on the succeeding terms of the expressions for individual tides, as related to the magnitude of the tide, to the position on the sea-coast, to the position on the river, &c.; comparison with the terms given by the theory of waves; discussion of the quarto-diurnal tides.

Section XVII.—Separate discussion of the tidal observations at Courtown.

Section XVIII.—Examination into the question of tertio-diurnal tide.

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January 16, 1845.

SIR JAMES CLARK ROSS, V.P., in the Chair.

“On the Liquefaction and Solidification of Bodies generally existing as Gases.” By Michael Faraday, Esq., F.R.S., D.C.L., &c.

The method employed by the author for examining the capability of gases to assume the liquid or solid form, consisted in combining the condensing powers of mechanical compression with that of very

considerable depressions of temperature. The first object was obtained by the successive action of two air-pumps; the first having a piston of one inch in diameter, by which the gas to be condensed was forced into the cylinder of the second pump, the diameter of whose piston was only half an inch. The tubes into which the air, thus further condensed, was made to pass, were of green bottle glass, from one-sixth to one-quarter of an inch in external diameter, and had a curvature at one portion of their length adapted to immersion in a cooling mixture: they were provided with suitable stop-cocks, screws, connecting pieces, and terminal caps, all very carefully made, and rendered sufficiently air-tight to retain their gaseous contents under the circumstances of the experiments, and when they were sustaining a pressure of fifty atmospheres, as ascertained by mercurial gauges connected with the apparatus. Cold was applied to the curved portions of the tube by their immersion in a bath of Thilorier's mixture of solid carbonic acid and ether. The degree of cold thus produced, when the mixture was surrounded by the air, estimated by an alcohol thermometer, was a temperature of  $-106^{\circ}$  Fahr. But on placing the mixture under an air-pump, and removing the atmospheric pressure, leaving only that of the vapour of carbonic acid, which amounted only to 1-24th of the former, (that is to the pressure of a column of 1.2 inch of mercury,) the thermometer indicated a temperature of  $166^{\circ}$  below zero of Fahrenheit's scale. In this state, the ether was very fluid; and the bath could be kept in good order for a quarter of an hour at a time.

The author found that there were many gases which, on being subjected to cold of this extreme intensity, condensed into liquids, even without a greater condensation than that arising from the ordinary atmospheric pressure, and that they could then be preserved, sealed up in glass tubes, in this liquid state. Such was the case with chlorine, cyanogen, ammonia, sulphuretted hydrogen, arseniuretted hydrogen, hydroiodic acid, hydrobromic acid, carbonic acid, and euchlorine. With respect to some other gases, such as nitric oxide, fluosilicon, and olefant gas, it was difficult to retain them for any length of time in the tubes, in consequence of the chemical action they exerted on the cements used in the joinings of caps and other parts of the apparatus. Hydroiodic and hydrobromic acids could be obtained either in the solid or liquid state. Muriatic acid gas did not freeze at the lowest temperature to which it could be subjected. Sulphurous acid froze into transparent and colourless crystals, of greater specific gravity than the liquid out of which they were formed. Sulphuretted hydrogen solidified in masses of confused crystals of a white colour, at a temperature of  $-122^{\circ}$  Fahr. Euchlorine was easily converted from the gaseous state into a solid crystalline body, which, by a slight increase of temperature, melted into an orange-red fluid. Nitrous oxide was obtained solid at the temperature of the carbonic acid bath *in vacuo*, and then appeared as a beautifully clear and colourless crystalline body. The author conceives that in this state it might, in certain cases, be substituted with advantage for carbonic acid in frigorific processes, for arriving at degrees of

cold far below those hitherto attained by the employment of the latter substance. Ammonia was obtained in the state of solid white crystals, and retained this form at a temperature of  $-103^{\circ}$ .

The following liquids could not be made to freeze at  $-166^{\circ}$ ; namely, chlorine, ether, alcohol, sulphuret of carbon, caoutchoucine, camphine, and rectified oil of turpentine.

The following gases showed no signs of liquefaction when cooled by the carbonic acid bath, even when subjected to great pressure; namely,

Hydrogen, Oxygen, at a pressure of . . . . 27 atmospheres.

Nitrogen and nitric oxide at a pressure of 50 atmospheres.

Carbonic oxide at a pressure of . . . . . 40 atmospheres.

Coal-gas at a pressure of . . . . . 32 atmospheres.

January 23, 1845.

SIR JOHN WILLIAM LUBBOCK, Bart., V.P. and Treas. in  
the Chair.

1. "Observations de la Déclinaison et Intensité Horizontales Magnétiques observées à Milan pendant vingt-quatre heures consécutives le 29 et 30 de Décembre 1844." Par M. Carlini.

2. "Remarks having reference to the Earthquake felt in Demerara on the morning of the 30th of August 1844." By Daniel Blair, Esq., Colonial Surgeon of British Guiana. Communicated by the Right Honourable Lord Stanley.

The earthquake here described commenced at twenty-seven minutes past three o'clock, a.m. on the 30th of August, and continued during two or three minutes. It appeared to be composed of two waves or pulsations quickly succeeding each other, and producing gyratory movements of the earth. Though the alarm it occasioned was very great, no serious damage seems to have resulted from it.

3. "An Account of the artificial formation of a Vegeto-alkali." By George Fownes, Esq., Chemical Lecturer in the Medical School of the Middlesex Hospital. Communicated by Thomas Graham, Esq., F.R.S., Professor of Chemistry in University College.

The substance which is the subject of investigation in this paper is a volatile oil, obtained by distillation from a mixture of bran, sulphuric acid and water, and is designated by the author by the name of *furfurol*. Its chemical composition is expressed by the formula  $C^{15}H^6O^6$ , and its properties are the following:—When free from water and freshly rectified, it is nearly colourless; but after a few hours, it acquires a brownish tint, which eventually deepens almost to blackness. When in contact with water, or when not properly rendered anhydrous, it is less subject to change, and merely assumes a yellow colour. Its odour resembles that of a mixture of bitter almond oil and oil of cassia, but has less fragrance. Its specific